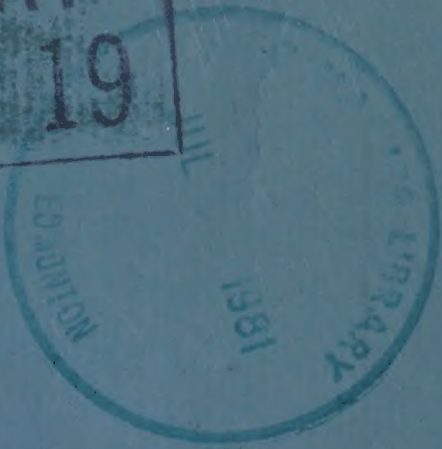


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REPORT

of the

Commission to enquire into the ~

CAUSE OF MINE EXPLOSION

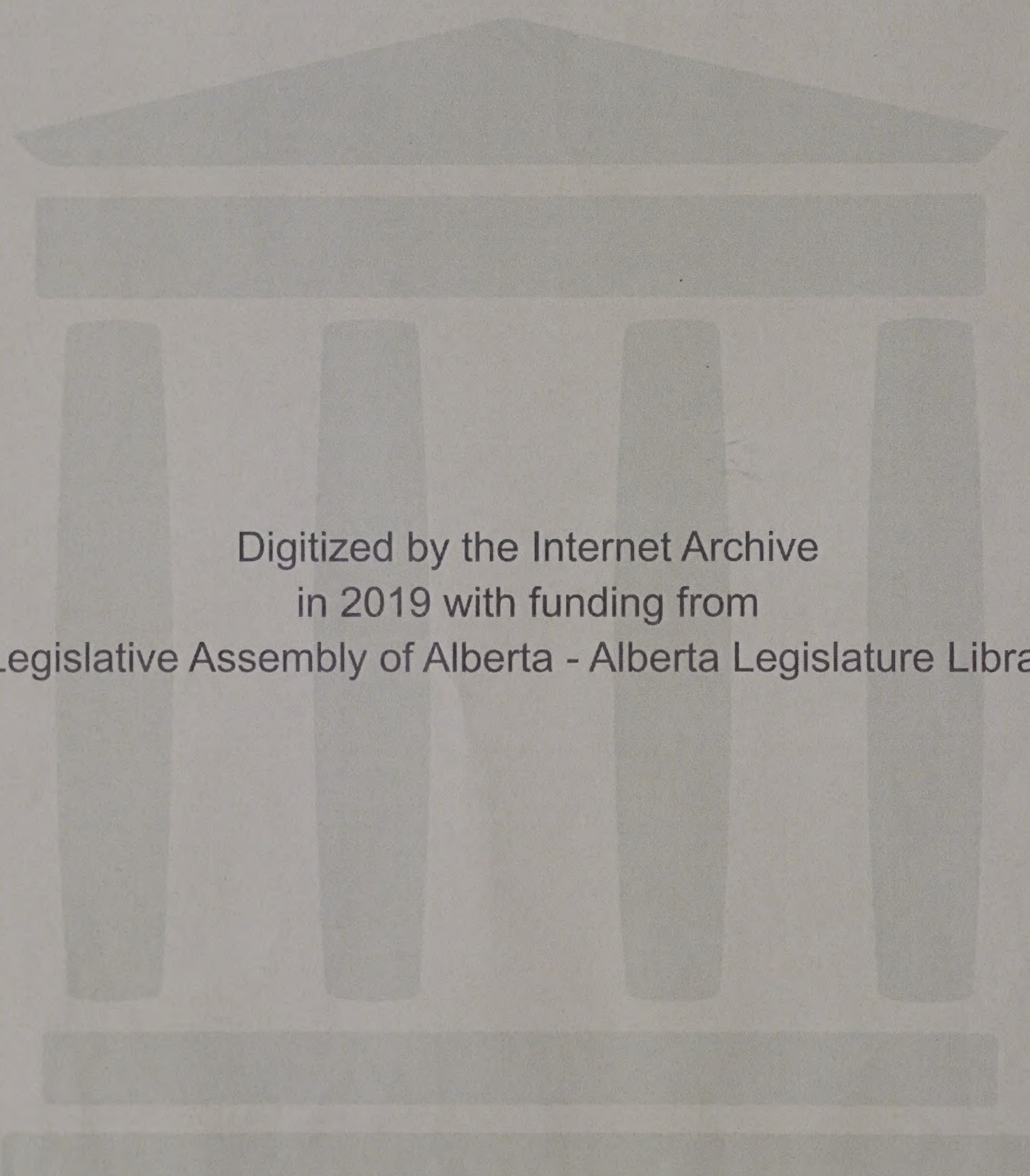
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To His Honour,

The Lieutenant Governor in Council,

Sir:-

Under your commission to conduct an enquiry according to the provisions of the Public Enquiries Act to ascertain so far as possible the cause of the explosion in the Imperial Mine operated by the Lethbridge Collieries at Coalhurst, Alberta, whereby sixteen men lost their lives, I now beg to submit my report.

The explosion took place on December 9th, 1935, at approximately 3.30 o'clock in the afternoon. The working places were 583 feet below the surface and ~~6~~200 feet from the shaft. Mining operations by this company in this district had been carried on since 1911. The miners engaged in operations at the time of the explosion were nearly all men of many years experience, the majority having been in this particular field for a considerable period. The work came under the head of what is called "retreating", that is as the coal was taken from the rooms the pillars were extracted and that particular section of the mine was to be abandoned.

The day shift started work at eight o'clock in the morning but before they went below the fire boss made a tour of inspection of the roadways, airways and ventilation. He used a safety lamp to investigate for gas in the morning and a Burrill gas detector as well in the afternoon. It was his duty to inspect the working places for gas twice a day and report his findings in a book kept for that purpose. He also made markings in the different rooms to show they had been inspected and approved, which markings were noted by the miners on going to work.

On the day of the explosion twenty-eight men were engaged in the day shift, four other men had gone down to work in the mine at three o'clock in the afternoon, one man had come up at one o'clock in the afternoon and a number who had finished working before three o'clock were on their way to the shaft when the explosion occurred. All the men who were in the vicinity of the explosion were killed.

Air is circulated in this mine by means of a fan operated from the surface. The fan is a Walker Indestructible Centrifugal Fan. The air is forced down into the mine by a fan situated at the top of the air shaft. The main air current travels south to the intersection of the first east and west airways and then splits, some going east and some west. It also continues further south and splits again to the east and west, ventilating the old workings so far as they could be ventilated, and the air current which ventilates the one-third southeast portion of this section of the mine travels straight along over the overcast and along the airway. It returns by way of what is called the full road.

As the air travels along the airway a certain amount of it is deviated by what are called "splits".

During the course of the enquiry considerable attention was called to the airway cross-cut where the air line split. This cross-cut connected the empty road and the full road. There was a door constructed here for the purpose of preventing air from proceeding in too great quantities through the opening and for the better distribution of air it was necessary that this door should be closed except when a load was passing through. Some witnesses stated this door on the airway cross-cut was frequently propped open. Others reported seeing it open from time to time and in any event as the traffic was heavy - about one-half the output of coal being sent through

this cross-cut from the empty road to the full road - the door was necessarily open a considerable part of the time. The suggestion was made that another cross-cut might have been used for transportation of mine cars from the empty to the full road at a point where the deviation of the air would not have been so effective. This suggestion seems a good one but it should be stated that even under the conditions which existed, the quantity of air supplied to the workings was considerably in excess of the minimum amount required under the Act.

Eleven rooms were in operation on the day of the explosion.

A number of the miners who had been employed at 7 and 8 butt and at 13 and 14 butt, testified that there were occasions when they did not have sufficient air; that they had complained of the situation from time to time to the fire boss and to the pit boss. Other miners working in the same district said they found the air supply satisfactory. On many occasions the compressed air line was opened up to improve the atmosphere in some of the rooms, particularly to clear away the smoke after a shot had been fired. When the miners working in a room had completed their preparations the fire boss - White was the fire boss on the day of the explosion - fired the shot which loosened the coal in the room. Immediately after the firing of the shot the compressed air was turned on in the room to drive the smoke out. The compressed air was primarily needed for the machine cutters. Miners in different rooms from time to time turned on the compressed air to improve the ventilation. To prevent too great use of the compressed air in this way the valves on the compressed air equipment had been removed. This was not done because of any danger from the use of the compressed air but because it was required for the machine cutters.

In two of the rooms compressed air was necessary for ventilation as there was no direct air current to these rooms. This particular condition in regard to these two rooms did not last a long time as the two rooms had only recently been opened up. Four of the men who had been working in the mine on the day of the explosion, and who were well on their way to the shaft at the time of the explosion, said the air had been bad that day. Four others said there was nothing unusual about the air that day, and two others said the air was good.

Harry White, fire boss, who has been employed in the mine for twenty years and who has been an examiner for two years, made his usual inspection for gas on the morning of December 9th. He tested the rooms and other portions of the mine, and I might mention particularly, that he tested at the place referred to as "the overcast". He found no traces of gas. In the afternoon he made his usual inspections for gas but did not again make a test at the overcast. At this overcast the air goes into another section. There was a cave here and White thought that this was a likely place for gas and accordingly made his test in the morning at that point. The particular reason given by White for testing for gas at the "cave" was because it was a likely place for gas. He fired a number of shots in the different rooms and the last shot he stated was fired at 2.35 p.m. There was nothing unusual, White stated, in the working conditions on that day.

John Thompson, pit boss, made a tour of the mine at 2 p.m. on December 9th. He found all the rooms but one in good shape on the airway side, and that particular room was up against a fault and there was no more work to be done in it. He saw White making tests for gas. The last shot, according to Thompson, was fired in room 5 on the airway at about 2.25 p.m. There was nothing unusual regarding the ventilation and there had been no complaints made to him on the day of the accident. In regard to the door in

the airway cross-cut, Thompson stated that this should be kept closed to prevent the air from short-circuiting.

Samples of air were taken on December 27th at the "overcast" and were forwarded to the Mines Branch, at Ottawa for analysis. Samples were taken from a cavity on the empty road up in the roof of the cavity but at different locations, some closer to the roof than others. One of these samples showed .34% of methane; another showing 7.13% of methane, a very explosive mixture; at the overcast one sample showed 25.35% of methane, which would not be an explosive mixture, being above the explosive limit; another taken at the overcast showed 25.48% of methane.

Running through the mine was an electrical signal system carrying 110 volts. This did not comply with the regulations of the Mines Act which reads "where electricity is used for signalling the pressure shall not exceed 15 volts". This system had been installed a long time previously, having been in operation for fifteen or twenty years. William McMahon, master mechanic, said that, while 110 volts of static electricity were present, that, after this had passed through the signal lamp, the voltage, he thought, was cut down below fifteen volts. There was also a bell rung by this signal system which helped to cut down the voltage. Experiments were made by Dr. H. J. MacLeod, Professor of Electrical Engineering, University of Alberta, with a signal system similar to that in the mine. He worked out these experiments with Dr. Edward H. Boomer, Professor of Chemistry at the same University. Dr. MacLeod found from the experiments that a circuit containing 124 volts and .5 amperes, as was the case in the signalling system in the mine, would not explode a mixture of methane gas and air.

There was also a question as to safety lamps used in the mine. Dr. MacLeod was of the opinion that such a lamp, the lens and bulb being broken, having a voltage of ^{2.4}~~.24~~ and an amperage of 1.2, when fully charged, dropping down to 1.1 after

eight hours use, would, under certain conditions, produce a glow in the filament of the lamp which might be sufficient to ignite an inflammable mixture of gas and air. He referred to a paper published by the Safety Mines Research Board and printed in the Colliery Guardian of November 10th, 1933, by G. Allsop and T.S.E. Thomas.

The questions put to Dr. MacLeod and the answers given by him were:

"Q. Well I think your statement was that there would be a possibility of a sudden breaking of one of these lamp bulbs, the type of lamp used by these miners, causing an ignition of fire damp, and air in the proper proportion?

A. Yes, I would say that would be possible, depending of course upon the time which elapses between the breaking of the bulb and the breaking of the current, which these articles show is extraordinarily short.

Q. Can you express any opinion as to whether a blow could break the outside lens of the safety lamp and the bulb without breaking the filament?

A. In my opinion it would be possible to do that. It would be rather unlikely.

Q. Rather unlikely but there would be the possibility and if the blown filament were exposed to a mixture in the proper proportions I suppose you would say it could ignite that mixture?

A. Yes, these experiments show that it would do that."

On another point which was raised in regard to the safety lamp, Dr. MacLeod was told that some of the tin containers of the batteries had become unlocked on different occasions and there might be a sparking between one of the poles and the lid of the battery or something of that nature. His reply was that there

might be a spark obtained in the manner suggested but if the current still continued to go through the filament the current and the voltage would both be so low that gas could not possibly be ignited.

Evidence was submitted that sparks were sometimes caused by the grippers on the mine cars. Dr. Boomer said that at various enquiries the suggestion had been made that sparks had caused fire damp explosions, but in the laboratory very violent showers of sparks have not ignited a mixture.

A cable for the purpose of hauling the cars extended from the shaft to the inner end of the workings. This was in charge of Mike Negrello who was stationed at the shaft bottom. He stopped the rope when signalled from within the mine. The signal wires would be touched together and as a result a bell would ring in his room and a light would flash. On the afternoon of December 9th, so far as Negrello can remember, no signals were received. The rope had not been stopped all day until 3.25 p.m. when it slackened on the drum and Negrello threw the clutch over as he knew there was something wrong. Shortly after he learned of the explosion. On that day 180 cars had been loaded in the mine. At the time of the explosion Julius Popp was in charge of 46 cars. He stated he had given a signal at 2 p.m. and after that the rope operated continuously until the blast. At the time of the explosion he was taking a full load out and was knocked from a car. He fell on the tracks and when he got up the rope had stopped and the cars were not moving.

An outstanding phase of the situation developed in the mine immediately upon the occurrence of the explosion was the bravery displayed by the miners and the officials. There were twelve men in the mine on their way out when the explosion took place. Of these John Ramage, who had left his room at 3.15 p.m. was burned about the back of the neck. He, like the others who

The first part of the book is devoted to a general survey of the history of the world, from the beginning of time to the present day. The author discusses the various stages of human development, from the earliest primitive societies to the modern world of science and technology.

In the second part, the author examines the political and social changes that have shaped the modern world. He discusses the rise of the nation-state, the development of democracy, and the impact of the Industrial Revolution on society.

The third part of the book is devoted to a detailed study of the various civilizations that have flourished throughout history. The author discusses the achievements of ancient Egypt, Greece, Rome, China, and the Islamic world, among others. He also examines the contributions of the Renaissance and the Enlightenment to modern thought.

The fourth part of the book is a critical analysis of the modern world. The author discusses the challenges posed by the Industrial Revolution, the rise of imperialism, and the impact of the two world wars. He also examines the role of the United Nations and the prospects for a more peaceful and just world.

The book is written in a clear and concise style, and it is well illustrated with numerous photographs and maps. It is a valuable resource for anyone interested in the history of the world and the development of human civilization.

escaped, said there was a great deal of dust and some sparks.

As soon as he partially recovered from the force of the explosion he went back into the mine and met his son, John Jr., coming out. They both went further back and brought out John Sicardo. William Ramage was not injured. He turned back to assist in locating his father. As he put it "blood is thicker than water and I had a father and brother in there". After coming to the bottom he again went back to take part in rescue work.

Upon word reaching the surface the mine manager, John M. Davidson, Pete Melling and Connors went down into the workings without any protective apparatus. Already inside the mine when they arrived were Harry White, John Thompson, Alexander Birse, Charlie Gresl, Alexander Hunter and William Ramage. Thompson and White had gone in first followed by Birse, Gresl, Hunter and William Ramage. After Davidson, Melling and Connors arrived at the bottom, J. B. deHart, inspector, and Mr. McAndrews arrived. These men and officials had gone into the mine without any equipment and proceeded well into the working part in an effort to locate some of the men who might still be alive. Later the mine rescue crew arrived equipped with protective apparatus. A short time after that the rescue crew from the Shaughnessy Mine arrived and assisted in the work of exploration and recovery of the bodies. These men who went into the mine unprotected and careless of the risks they were undergoing, are entitled to all credit that can be given for such an action. The members of the rescue crews too arrived promptly upon receipt of notice and did particularly fine work during the evening, continuing until their services were no longer required.

As to the cause of the explosion the opinion was almost unanimous that the gas came from the old workings over the cave at the overcast.

This was not considered a gaseous mine, very few traces of gas in any quantity having been found there during the

years of operation.

The possibility of ignition through sparks from the endless chain used to haul the cars does not seem likely; the possibility of ignition from falling rock in the old workings, while suggested, does not appear apt in view of the evidence of Dr. Boomer; the possibility of ignition through the act of a miner in striking a match or a cigarette lighter was not advanced by any witness. All the men underground that day were experienced miners and could be trusted not to use matches while underground; the possibility of ignition from a battery short-circuiting in a lamp does not appeal, clear evidence of its improbability having been demonstrated by the experiments which were carried on and explained at length during the course of the inquiry.

What is left is the possibility of the bursting of a bulb and filament in a miner's lamp, if the glowing filament were sufficient to cause ignition of the gas.

The Mine Safety Appliances Company of Pittsburgh communicated with me after the conclusion of the hearing at Lethbridge, and copies of the statements sent by them were forwarded by me to counsel representing the different parties at the enquiry. Graham Bright, chief electrical engineer of the company, says that he has been present at many tests and that when a lamp is finally approved there is no question whatever as to its being safe for use in any gaseous atmosphere that may occur in and about coal mines. Mr. Bright enclosed a letter from L. C. Ilsley, supervising engineer, electrical section, United States Department of the Interior, and the concluding paragraph of the letter is "Although electric cap lamps have been in constant use in mines for over twenty years, and their numbers run into thousands, the Bureau has no record where a permissible electric cap lamp has ignited methane either from a short circuit of the battery or from the breaking of the bulb."

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Joseph B. deHart, Provincial Government Inspector of Mines in the district, said the Imperial was not considered a gaseous mine. Gas had been found there in limited quantities. In 1935 he made four reports on the mine. In his report of March 26th he found a trace of gas, probably less than 1-1/4% after a very careful inspection. There was an explosive mixture over the cavity in 6 butt room. He had not found a large accumulation of gas in recent years. In his examinations of the mine in May and September the ventilation was good and no trace of gas was found. Mr. deHart found there was sufficient air going into the area covered by the explosion to supply that particular district at the time of the explosion providing it was getting into the working places. Mr. deHart's opinion is that the ignition occurred at or near the 13 butt overcast, the gas coming probably from the worked out areas in 13 and 14 butts and 7 and 8 butts, mostly from 13 butt and possibly 14 butt entries. There may have been an accumulation of gas in the old workings, gradually accumulated since they were abandoned, or there may have been very little gas in the old workings. If there was a lot of gas the barometer had a great deal to do with the condition. The barometer had been dropping rapidly since midnight and there was a particularly fast drop between 3 and 3.20 p.m. Mr. deHart's opinion is that the explosion occurred just inside the old workings, that the ignition was outside and part of the explosion possibly outside, but most of it was in the old workings. There were two possibilities he thought; a defective or broken safety lamp or an open flame. It would be possible to ignite those gases through the breaking of the headlight and bulb of a miner's lamp.

"By recent tests", said Mr. deHart, "it has been shown the tremendously short safety factor you have when you break a bulb to put out the glow of the wire before gas could be ignited. Tests were made by the British Safety Mines Research

"Branch, and Dr. MacLeod quoted it, and under the tests these
"two ampere lamps have to be broken, or a similar class to ours in
".012 of a second after the bulb to prevent ignition. Q. I think
"it is between .02 and .12 is it not? A. Yes. Two-hundredths of
"a second is a very small period of time. The safety device
"consists of a spring behind the bulb. The bulb is held by a clip
"over the top and at the base is a spring, and the theory always
"was if the bulb were broken the spring would eject it and break
"contact, but with these actual tests, which are comparatively
"recent, we don't know whether our contact is made in two-hundredths
"of a second; we haven't any means of determining, other than waiting
"for the British people, the Bureau of Mines, to make their tests.
"At any rate, I think it is the best lamp we have got. It is up-
"to-date, and the British tests are very interesting, especially
"with regard to the lamps that you get that are over two amperes,
"and a lot of these Edison lamps are over two amperes, and you must
"break your contact before the bulb is broken, which possibility is
"negative, which is an impossibility; so with larger lights it is
"a question of where we are heading with damaged lamps."

Mr. John M. Davidson, manager of the mine, is of the
belief that the explosion took place entirely in the old workings.
He would not venture an opinion as to the cause of the ignition.

William G. Healey, district inspector of mines, came
from Canmore and inspected the Imperial mine on December 10th,
along with other officials and members of the miners' committee.
His conclusion was that the explosion had taken place at or near
the overcast. He was inclined to the belief that some man at or
near the overcast may have run into a nail, may have broken his
front glass, probably punctured a hole in it, and that the ignition
was caused by that lamp. Mr. Healey was asked to suggest a remedy
to meet the possibilities of danger as they appeared from his
investigation in the mines and his reply was that the only absolute-

ly safe remedy is to have plenty of ventilation passing the ends of the old workings to dilute and render harmless all noxious gases. He was of the opinion that the ventilation in the mine would be ample to take care of any gas which might reasonably have been anticipated, considering the history of the area.

Peter Barkley, Vice-President of the Mine Workers' Union, found a condition of the airway in a portion of the road, forming a bottle neck which he considered bad practice. This condition he thought would militate against the air going forward properly. He stated "So far as we, the miners, are concerned we contend that these old workings, 7 and 8, 13 and 14, should have been sealed off by cog stoppers. I believe a sharp blow on the bulb itself would be sufficient to shatter the filament, but there is another little device in there, I believe a spring clip of some kind, where the filament is attached before it proceeds into the connections inside and I think the chances are about one in a million of the bulb being broken without also the filament being broken, and sufficient heat left in the glowing filament to ignite the gas. I think if the bulb was broken or anything happen to the head lamp that the lamp would be extinguished. In my opinion the cause of the explosion is the slow and uncontrolled accumulation of gas in the old workings. I believe there was a considerable volume of gas, as has been computed at 2500 cubic feet, and I believe that most of this was in the old workings. This gas in the old workings I believe was eddying back and forth because of the state of the intake airway on the empty road, the door being open on the airway almost continuously, being plugged with empty cars and this would mean there would be times when the intake air would move pretty readily and other times when it would be almost stagnant, and the intake air towards these old workings would be thrown into the old workings, thrown into these entries in the same way as waves lapping on the seashore and receding again. Because of this condition of

the intake airway methane gas was forced out over the top of the caves on to the return airway". Mr. Barkley's theory is that there was a major settling in the old workings and when that occurred the gas became heated and was thrown out, the explosion taking place immediately thereafter. His suggestion was that, if the old workings had been properly sealed off, there would have been no explosion.

Andrew A. Millar, Chief Inspector of Mines for the Province of Alberta, took part in the inspection of the mine on December 10th. He stated that he agreed entirely with the evidence given by, and the findings arrived at by Mr. deHart. He thinks the only two possible sources of ignition were an open light or a defective or damaged lamp coming in contact with an explosive mixture at the overcast. His conclusion was that the ignition occurred on the full road and the explosion started on the full road at 13 butt. He cannot conceive of an explosion having taken place through the compression of gases.

Marc Piard made an inspection of the mine on December 24th. His theory is that there was gas in the roof, in the shale, and the pressure of this on the roof caused a kink underneath which caused a concussion. The air would be compressed and an explosion result. The remedy in his opinion is an adequate ventilation which at all times clears all places. He also suggested a plugging or blocking of the old works was a palliative, which might be done too late.

Thomas Graham, a member of the Canadian Institute of Mining Engineers since 1908, and a mining man of many years standing, made a visit to the mine on December 18th at the request of the management. He came to the conclusion that the ignition occurred at the overcast at the contact between the old workings and the ventilating current. When asked if he had any idea of the likely cause of the explosion he said "I have tried to eliminate many

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things and come back to the point where there must have been either a defective lamp or a broken lamp or an open flame of some kind." The ignition, he thinks, took place in the present workings, the gas coming from the old workings through the overcast to the to the face of 13 butt.

Mr. Graham had worked in this district in 1913 and it was generally accepted as a non-gaseous field. It had been suggested during the course of the enquiry that the old workings might have been clogged and filled, thus preventing the escape of gas into the new workings. Mr. Graham did not think that system would afford perfect protection. He said that the State of Pennsylvania, which produces coal in very large quantities, prohibits the sealing of abandoned workings. There are two views with respect to the sealing and leaving open of abandoned areas.

In my opinion the evidence clearly established that the explosion was caused by gas which had formed at the cave or overcast, that the gas came from the old workings and the explosion may have occurred in the old workings or in the new workings. The ignition was caused by an open flame or from a damaged lamp, and there is some circumstantial evidence as to the finding of a broken lamp near the spot of ignition which corroborates that theory.

Section 87 of The Coal Mines Regulation Act, 1930, Ch. 24 provides "An adequate amount of ventilation shall be constantly produced in every mine to dilute and render harmless noxious gases, to such an extent that the working places of the shafts, levels, stables and workings of the mines and the travelling roads to and from such working places shall be in a fit state for working and passing therein.

"An adequate amount of ventilation shall mean not less than two hundred cubic feet of pure air per minute for each person, horse and mule employed in the mine, and as much more as

the District Inspector may direct."

As before stated the ventilation in this mine was well in excess of the minimum requirements of the Act.

I would suggest, being in agreement with a number of the experts called, that the safest remedy for a possible recurrence of such a catastrophe is to have plenty of ventilation passing through the ends of the old workings. In that way the probability of rendering harmless all noxious gases might be increased.

Particular attention should be paid also to doorways such as that mentioned on the airways cross-cut, and such openings should be checked frequently to see that the passage of air through the mine is not short-circuited.

During the course of the enquiry seventy-two witnesses were examined, the evidence extended over thirteen hundred and fifty pages, and forty-three exhibits were filed. As it could not be ascertained until the conclusion of the enquiry what bearing certain evidence might have I allowed considerable latitude in the presentation of the evidence that might in any way be pertinent to the enquiry.

The conduct of the enquiry was made easy by the assistance rendered by Counsel and witnesses.

Accompanying this report is a transcript of the evidence and a list of the exhibits, which are on file in the Court House at Lethbridge.

Your obedient servant,

(Signed) H. W. Lunney

Commissioner.

Dated at Calgary, Alberta,
this 14th day of April,
1936.

